MONASH University

MONASH INNOVATION

CYRENE™ BASED POLYMER: USE IN COATINGS

Cyrene™ is synthesised from Australian pine wood as a green solvent. Monash researchers have developed polymers of methacyrlic Cyrene. Coatings containing this polymer have excellent thermal stability and rigidity/hardness.

- **New polymer for coatings additive made from Green bio-derived monomer**
- **Improved Thermal Stability compared to isobornyl methacrylate (IBMA)**
- **Higher T_g (rigidity, hardness) compared to IBMA**
- **Fast polymerisation kinetics compared to IBMA**
- **Current testing suggests polymer has low toxicity**

THE CHALLENGE

The challenge in the 21st century is to replace non-green products with green equivalents that are superior or at least equivalent in performance or that can be used for high value niche applications.

Our researchers have developed new polymer chemistry starting with a “green” monomer and demonstrated the use of this polymer as an additive for coatings.

Additives such as IBMA are primarily used in industrial paints and coatings, for metal, glass, and plastics. It is desirable for certain demanding applications using polymeric coatings that further improvements in thermal stability and hardness are achieved.

Other challenges for paints and coatings are to minimise the quantity of expensive specialty monomers used in a polymerisable formulation, while maintaining acceptable properties.

In addition to reducing the amount of additive needed, it is now considered important to replace additives with bio-derived material from sustainable resources.

THE TECHNOLOGY

Our researchers have developed a new methacrylic monomer and, subsequently, a polymer from Cyrene™ which is derived from Australian pine wood and is considered as high boiling green solvent.

With an easy and scalable two-step synthesis process, the overall yield of the monomer is high.

From the kinetics study, this monomer is found to undergo fast polymerization with a high yield mainly with polar solvents and in water (emulsion polymerization).

The glass transition temperature (T_g) of the homopolymer was found to be 162°C (for bulk polymerization) and 193°C (for emulsion polymerization) and is believed to be one of the highest reported for methacrylic polymers (Figure 1). This high glass temperature of the polymer give rise to high rigidity and hardness which makes it suitable for application for high mechanical strength.

The homopolymer is stable up to 290°C for bulk phase polymerisation or 310°C for emulsion polymerisation (Figure 2). Such stabilities are considered acceptable for applications like automotive OEM and refinish applications which require high temperature baking of polymeric resins.

Addition of this monomer (10% by w/w) into a coating formulation increased the molecular weight (MW) by 7000, the polydispersity (*Đ)* by 2.0, T_g by 25°C and thermal stability by 100°C, which makes it a very suitable candidate for coating formulations.

The current cytotoxicity test shows the monomer is non-toxic against skin cells and hence is believed to be safe to handle.

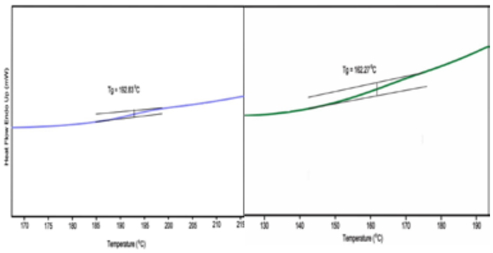

Figure 1. Glass transition temperature of m-Cyrene homopolymer by emulsion polymerization (left) and bulk polymerization (right).

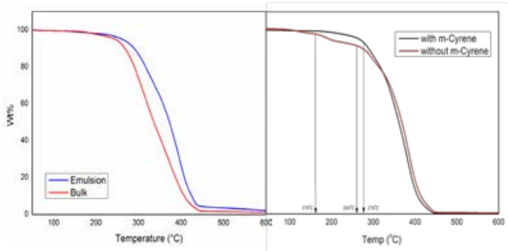

Figure.2. Thermal stability of m-Cyrene homopolymers (left) and coatings with and without m-Cyrene (right).

THE OPPORTUNITY

Monash seeks a partner to further develop this technology to the point of a commercial product and process.

The Monash research team includes Assoc Prof Kei Saito and Prof George Simon who have extensive experience in green chemistry and in polymer chemistry.

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